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Efficacy of a home exercise program on balance, kinesiophobia, pain and quality of life in post-COVID-19 patients

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Abstract
Aim: In this study, we aimed to determine the effects of a home exercise program on patients who treated for COVID-19 in the pandemic ward.
Material and Methods: In this randomized, clinical, single-blinded, controlled study, 82 patients who were discharged after completing their COVID-19 treatment were included in the study, and demographic data were recorded by dividing them into two groups as experimental (n=42) and control (n=40). Joint range of motion (ROM) and balance exercises were recommended for the experimental group as a home exercise program, while the control group did not receive any intervention. The home exercise program was implemented 5 days a week for 4 weeks. All the patients were evaluated in terms of quality of life (Nottingham Health Profile (NHP)), kinesiophobia (Tampa Scale of Kinesiophobia), balance (Berg Balance Scale), pain (Visual Analog Scale) before and after the intervention.
Results: In both groups, a statistically significant difference was observed in the quality of life, balance and pain levels after the intervention ($p<0.05$). After the intervention, there was a statistically significant improvement in kinesiophobia in the experimental group ($p<0.05$), no statistically significant difference was found in kinesiophobia in the control group ($p<0.05$). In the comparison between the groups after intervention, a statistically significant difference was observed in terms of quality of life (NHP part 2), kinesiophobia, balance, with the results being in favor of the experimental group.
Discussion: ROM and balance exercises for post-COVID-19 patients at the time of discharge are effective in improving quality of life, balance and kinesiophobia, but their effects on pain remain unclear.

Keywords
Home Exercise Program, Balance, Kinesiophobia, COVID-19

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Introduction

Coronaviruses (CoVs) are a large group of viruses, which cause a variety of diseases ranging from the common cold to more serious clinical conditions, such as severe respiratory syndromes [1]. Since it was declared a global pandemic, the most important issue with a kind of Coronavirus named COVID-19 has been its high rate of transmission, infecting millions of people worldwide and causing mortality in some cases. In addition to mild symptoms, such as fever, dry cough, and fatigue, approximately 80% of patients develop respiratory distress or respiratory failure symptoms and require hospitalization or intensive care [2].

Patients who stay in the inpatient ward for a long time have limited mobility in terms of exercise and endurance, which creates many problems. Studies have shown that appropriately structured, guided and supervised physical exercise programs have positive effects on the course of the disease by affecting the patient's inflammatory state through the recovery of antioxidant defenses [3]. In studies conducted in the literature, exercise prescriptions, including rehabilitation (e.g., joint range of motion exercises) and pulmonary exercises after COVID-19, have been conducted to have positive effects on the endurance of respiratory and cardiovascular systems and quality of life of patients [4]. In hospitalized patients, regardless of the reasons for hospitalization, immobility causes disruption in the balance components (weakness in the lower extremities, grip problems, and falls) [5]. In this respect, individuals infected with COVID-19 are also at risk of having balance problems. Kinesiophobia is defined as the fear of movement and is especially seen in diseases that require long-term hospitalization, present with balance problems or affect the musculoskeletal system [6]. It has been predicted that patients may have problems in moving and returning to work after a history of hospitalization due to COVID-19.

So that, this study is the first study in the literature to examine the effects of such a home exercise program on balance, kinesiophobia, pain and quality of life of post-COVID-19 patients.

Material and Methods

Study Design

Ethics Committee Approval was received on December 30, 2020 with the decision number 2020-08/06.

This randomized, clinical, single-blinded, controlled study was initially planned to include 90 patients who had been admitted to the pandemic ward of Physical Medicine and Rehabilitation Hospital with a diagnosis of COVID-19, completed their treatment, and were ready to be discharged. However, 4 patients did not meet the inclusion criteria, 4 did not attend their follow-up evaluation; therefore, the study was completed with 82 patients. All the patients included in the study received inpatient intervention for 14-21 days. None of the patients received intervention in the intensive care unit. The inclusion criteria were age 18-65 years, hospitalization in the pandemic ward due to moderate and severe COVID-19 pneumonia, and having completed COVID-19 treatment, oxygen saturation of over 95% at the time of discharge.

Exclusion criteria:

1. Diagnosis of advanced cardiac or lung disease for which exercise would be contraindicated
2. Presence of a cognitive disorder, receiving psychotherapy or any psychiatric treatment, ϕ disease affecting the central nervous system
3. Being illiterate
4. Having hearing, vision problems and vertigo or a disease that can cause vertigo
5. Inadequate function of any extremity that would prevent exercise
6. The presence of a balance disorder or a disease that can disrupt the balance (Parkinson's disease, a disease with cerebellum involvement, etc.)

The patients were randomized into two groups using the computer-assisted randomization method. The first group was prescribed a home exercise program, the second group was only followed up. All the patients were evaluated with the Nottingham Health Profile (NHP), Tampa Scale of Kinesiophobia (TSK), Berg Balance Scale (BBS), and Visual Analog Scale (VAS)-pain before the intervention and at the fourth week of intervention.

Study Design

Exercise protocol

Range of motion (ROM) exercises for the neck, shoulder, elbow, wrist, and fingers in the upper extremity, and the waist, hip, knee, ankle and toes in the lower extremity and balance exercises were planned as single leg stance, tandem standing stance, tandem walking, and sit-up exercises (available at: https://www.tftr.org.tr/uploads/Sokaga-cikma-yasagi-spor-yapmaya-engel-degil.pdf). These exercises were performed 5 days a week for a total of 4 weeks (totally 10 times each exercises). If patients had any complaint, such as pain, nausea, dizziness, chest pain, and palpitations during the exercise, they were asked to terminate the exercise and inform the responsible researcher. The continuity of the exercises was checked by the responsible physician by phone call every week. Written brochures were also given to the experimental group, and they were asked to mark the days when they did the prescribed exercises.

Evaluation parameters

All the patients provided written consent and filled in a demographic form, including questions on gender, age, smoking, chronic disease, physical activity, experienced fatigue, and had musculoskeletal pain after the diagnosis of COVID-19.

VAS: On a 10-point VAS scale, with 0 representing no pain and 10 representing very severe pain, all responses were recorded.

NHP: NHP consists of two parts. In the first part, a total of 38 items were scored based on yes-no questions presented under six subscales, namely pain, sensory reactions, sleep, social isolation, physical activity and energy (totally min=0, max= 600). In the second part, 7 questions assess whether the disease affects the individual's paid work, housework, social life, relationship with other people, sexual life, hobbies, holidays (min=0, max=7). The validity and reliability studies of the Turkish version have been previously undertaken [7].

TSK: TSK consists of 17 items, each scored from 1 (strongly disagree) to 4 (strongly agree). (min=17, max= 68) The validity and reliability of the Turkish version of this scale have been previously confirmed [8].

BBS: BBS consists of a total of 14 items and instructions to

follow for each item. Each item is scored from 0 to 4 (min=0, max=56). The Turkish validity and reliability of BBS have been previously established [9].

Statistical Analysis

Statistical analyses were performed using the IBM SPSS Statistics v. 24.0. Frequency tables and descriptive statistics were used. The conformity of the variables to the normal distribution was examined using visual (histogram and probability graphs) and analytical (Shapiro-Wilk test) methods. In accordance with normal distribution parametric methods, the independent-samples t-test (Z-table value) was used to compare the measurement values of the two independent groups. The significance of p-value was accepted as $p < 0.05$ in all statistics. In the power analysis via G*Power software v. 3.1.9.6. sampling calculation, the required sample size was obtained as 28 patients by taking the alpha value (p) as 0.05 and power as 95% [10].

Results

Demographic data and pre-intervention analysis are given in Table 1. There was no statistically significant difference between the groups ($p > 0.05$).

The post-intervention versus pre-intervention assessment revealed a statistically significant difference in the NPH part 1 and 2, TSK, BBS and VAS scores in the experimental group ($p<0.01$). In the control group, there was a statistically significant difference in all these parameters except for the TSK score in the post- intervention evaluation ($p> 0.05$) (Table 2).

In the comparison between the groups after intervention, there was a statistically significant difference in terms of the NHP part 2, TSK and BBS scores, and this significance was in favor of the experimental group. However, no significant difference was observed between the two groups in terms of their post-intervention NHP part 1 and VAS scores (Table 3) ($p > 0.05$).

Discussion

In this study, a significant improvement was found in both groups in terms of quality of life, balance and pain levels in the pre- intervention and post- intervention evaluations, while the improvement in kinesiophobia was significant only in the experimental group. In post-intervention comparisons

Table 1. Demographic data and pre-intervention analysis

Demographic Data		Control Group (n = 40)	Experimental Group (n = 42)	Inter-Group Comparison	
		n, (%)	n, (%)	p	x2
Gender	Female	24 (60)	28 (66.7)	0.531*	0.392
	Male	16 (40)	14 (33.3)		
Age (mean)		52.13 ± 10.68	46.00 ± 10.16	0.114*	1.580
Smoking Status	Smoker	2 (5)	4 (9.5)	0.442*	1.632
	Non-Smoker	38 (95)	37 (88.1)		
Chronic Disease	Yes	18 (45)	24 (57.1)	0.272*	3.135
	No	22 (55)	18 (42.9)		
Physical Activity	Yes	13 (32.5)	12 (28.6)	0.699*	0.149
	No	27 (67.5)	30 (71.4)		
Fatigue	Yes	36 (90)	39 (92.9)	0.643*	0.214
	No	4 (10)	3 (7.1)		
Musculoskeletal Pain	Yes	10 (25)	13 (31)	0.072*	1.717
	No	30 (75)	29 (69)		
				p	z
NHP-part 1		220.20±178.80	280.93±131.25	0.08**	-1,717
NHP-part 2		3.30±2.70	4.45±2.40	0.06**	-1,806
TSK		40.45±7.12	40.31±8.14	0.9**	-1,027
BBS		48.30±9.78	41.57±18.44	0.06**	-1,151
VAS		4.92±2.00	5.02±2.00	0.8**	-0,285

n: number of patients, %: percentage, *x2 = chi-square test ($p > 0.05$), n: number of patients, independent-samples t-test**, $p > 0.05$, NHP: Nottingham Health Profile, TSK: Tampa Scale of Kinesiophobia, BBS: Berg Balance Scale, VAS:Visual Analog Scale

Table 2. Comparison of the groups in terms of pre- intervention and post- intervention parameters

	Pre- intervention Control Group (n = 40)	Post- intervention Control Group (n = 40)	P value	Pre- intervention Experimental Group (n = 42)	Post- intervention Experimental Group (n = 42)	P value
NHP-part 1	220.20 ± 178.80	100.46 ± 113.39	p < 0.01	280.93 ± 131.25	79.99 ± 89.94	p < 0.01
NHP-part 2	3.30 ± 2.70	1.45 ± 2.41	p < 0.01	4.45 ± 2.40	0.43 ± 1.32	p < 0.01
TSK	40.45 ± 7.12	38.90 ± 5.75	0.07	40.31 ± 8.14	34.36 ± 4.87	p < 0.01
BBS	48.30 ± 9.78	54.63 ± 2.89	p < 0.01	41.57 ± 18.44	52.45 ± 5.40	p < 0.01
VAS	4.92 ± 2.00	4.81 ± 2.02	0.593	5.02 ± 2.00	4.5 ± 1.90	p < 0.01

n: number of patients, independent-samples t-test, $p < 0.05$, NHP: Nottingham Health Profile, TSK: Tampa Scale of Kinesiophobia, BBS: Berg Balance Scale, VAS:Visual Analog Scale

Table 3. Comparison of the post- intervention scores of the groups

	Post- intervention			
	Control Group (n = 40)	Experimental Group (n = 42)	Inter-group Comparison	
			p	z
NPH-part 1	100.46 ± 113.39	79.99 ± 89.94	0.373	-0.797
NPH-part 2	1.45 ± 2.41	0.43 ± 1.32	0.002	-2.686
TSK	38.90 ± 5.75	34.36 ± 4.87	p < 0.01	-3.326
BBS	54.63 ± 2.89	52.45 ± 5.40	0.02	-2.753
VAS	4.81 ± 2.02	4.5 ± 1.90	0,49	-0.997

n: number of patients, independent-samples t-test, p < 0.05, NHP: Nottingham Health Profile, TSK: Tampa Scale of Kinesiophobia, BBS: Berg Balance Scale, VAS:Visual Analog Scale

between the groups, a statistically significant difference was observed in the NHP part 2, TSK and BBS scores in favor of the experimental group.

In the literature, many patients discharged from the hospital after COVID-19 intervention are reported to have deteriorated respiratory function, decreased exercise capacity, reduced muscle strength, activity restrictions, and impaired quality of life, and this process can last up to six months [11-15]. In addition, in a previous study evaluating 280 patients who were discharged, 61.4% of these patients complained of decreased activity, and their needs were reported as exercise, diet regulation, and traditional Chinese medicine practices in order of frequency [16].

When patients discharged from the hospital after COVID-19 pneumonia treatment were examined, even after six weeks, there was still a significant impairment in the quality of life parameters (except pain), evaluated with the Short Form-36 questionnaire [17]. Consistently, in the current study, after implementing the home exercise program, the experimental group was found to have significantly improved NHP part 2 scores, which focus on areas of life commonly affected by health.

In a review on exercise program approaches, breathing, aerobic, strengthening and balance exercises were recommended as part of rehabilitation [18]. In light of this suggestion, we included exercises program and observed more positive results in the quality of life, balance and kinesiophobia parameters in the exercises group.

To our knowledge, this is the first study to evaluate COVID-19-related kinesiophobia. In a previous study examining kinesiophobia with chronic obstructive pulmonary disease, the rate of kinesiophobia was found to be significantly higher in patients with chronic obstructive pulmonary disease compared to healthy volunteers. The authors predicted that kinesiophobia might be associated with dyspnea, fatigue, and chronic diseases [19]. Similarly, in the current study, there was a significant improvement in the kinesiophobia values in the experimental group after the intervention, both compared to the control group and pre- intervention values.

In this study, balance exercises undertaken at home provided improvement in the BBS score; i.e., balance parameters, which is in agreement with the literature. In a study including 25 patients who had received COVID-19 intervention, 25 patients with acute exacerbation of chronic obstructive pulmonary disease and 25 healthy volunteers, it was determined that the static and dynamic balance parameters of the patients with a COVID-19 diagnosis were worse compared to the healthy volunteers [20].

Although we detected an improvement in both groups in terms of pain parameters compared to the initial parameters, neither group had a significant advantage over the other. In the literature, the incidence of headache is reported to increase in patients who have had COVID-19, which has resulted in the coining of the term 'new daily persistent headache' [21]. In 143 patients who were evaluated 60.3 days after the first symptom of COVID-19, joints and chest were determined to be the most common areas of pain [22]. However, there is a need for further studies involving more patient groups to reveal the causes of pain areas in patients after the COVID-19 infection.

As there is an improvement in the natural course of every disease, in the current study, an improvement was observed in the quality of life, balance and pain parameters compared to the initial parameters also in the control group. However, in the literature, it has been suggested that elderly patients with hypertension, chronic obstructive pulmonary disease, diabetes and other chronic diseases are at higher risk, and the course of comorbidities is more severe in these patients with COVID-19 [23]. Further studies are needed to clearly reveal the factors affecting recovery.

Limitations

The limitations of this study are that the localization of pain was not questioned and the type of chronic disease was not specified.

Conclusion

Significant improvement was found in both groups in terms of quality of life, balance, and pain levels in the post-intervention evaluation compared to the pre- intervention evaluation. However, the improvement in kinesiophobia was only significant in the experimental group. In post-intervention comparisons between the groups, a significant difference was observed in the NHP part 2, TSK and BBS scores in favor of the experimental group. The improvements in the quality of life, kinesiophobia and balance parameters of the experimental group compared to the control group are very important in terms of clearly revealing the factors affecting recovery after COVID-19 disease.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement
All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest
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